

## **II. REMARKS**

### **A. Introductory Remarks**

Reconsideration and allowance of this application is earnestly requested. Claims 8-19 are pending in this application. Claims 1-7 were previously canceled. Applicants, however, reserve the right to file a continuation or divisional application on the subject matter of any of the canceled claims. Claims 8 and 14 are currently amended. No new matter has been introduced by any of the amendments.

### **B. Substance of Telephonic Interview**

Applicants thank the Examiner for courtesies extended during telephonic discussions held on February 22, 2007. The following is Applicants' statement of the substance of those discussions.

Applicants discussed with the Examiner the nature of the rejections over Scherber and Wang in the Final Office Action mailed on October 11, 2006. In particular, Applicants discussed the strategy of distinguishing "etching" as recited in claims 8 and 14 over "chemical mechanical polishing" (CMP) disclosed in Wang and Scherber. Applicants discussed various strategies with the Examiner and the Examiner suggested that reciting "chemically etching" without the mechanical aspect in claims 8 and 14 would suffice to distinguish the invention over CMP of Scherber and Wang. Applicants thank the Examiner for providing her input into the claim amendments.

### **C. Rejection of Claims 8-19 Under §103(a) Should Be Withdrawn**

The Final Office Action dated October 11, 2006 rejected claims 8-19 under 35 U.S.C. §103(a) as allegedly obvious over U.S. Patent 5,858,813 ("Scherber") in view of U.S. Patent 6,569,349 ("Wang") for the reasons cited on the following pages. Applicants respectfully traverse these rejections.

#### **1. Invention of Claims 8 and 14**

In contrast to Scherber and Wang, Applicants respectfully submit that claims 8 and 14 have been amended to obviate the Examiner's remaining concerns. As amended, claims 8 and

14 now recite a method of chemically etching and cleaning a substrate comprising TiW alloy layer that does not involve chemical mechanical planarization (CMP) or polishing step. Thus, in view of the Applicant's amendment to claims 8 and 14 as per the Examiner's recommendations during the telephone conference held on February 22, 2007, Applicants respectfully request withdrawal of this rejection.

Further, it should be noted that this application is a CIP of application No. 09/226,996, filed on January 7, 1999, now U.S. Patent No. 6,635,186. Whereas the parent U.S. Patent 6,635,186 discloses and claims a method of CMP, this application additionally discloses and claims a method of chemically etching and cleaning TiW alloy layer using periodic acid or hydrogen peroxide as an oxidant. See paragraphs [0045] through [0055] including examples 1, 2, and 3 of the instant specification.

As one of skill in the art fully knows and appreciates, CMP process is significantly different from etching both in theory and practice. For example, Scherber, discloses and utilizes a CMP (chemical mechanical polishing) to planarize the surface of metal layers or thin-films during the various stages of device fabrication." See col. 1, lines 30-34. Scherber discloses that the CMP involves concurrent chemical and mechanical polishing of an overlying first layer to expose the surface of a non-planar second layer on which the first layer is formed. See col. 1, lines 35-38. Cleaning, as in the present application, may occur after the CMP process but not during. The instant specification also discloses "The CMP process removes the excess material through a wet chemical etch of the surface material followed by a mechanical abrasion of the etched surface." See paragraph [0044] in the instant specification. Thus, CMP involves a chemical and mechanical aspect to remove substrate and planarize the surface.

In contrast to CMP, the method of "etching" as described in the specification is another embodiment of the invention where an oxidizer such as periodic acid and hydrogen peroxide is used to "*dissolve*" the exposed TiW alloy substrate surface. See paragraphs [0060] - [0067] in the instant specification. Further, paragraph [0041] defines the meaning and phenomenon of "*Etching the surface*" as "*The impurity and a certain thickness of the substrate surface is dissolved.*" Similarly, Scherber discloses etching as "*The dissolution of aluminum after the abrasion (which is equivalent to wet etching) is low...*" See col. 9 lines 66-67. Thus, etching as

defined in both Scherber and in the instant specification is the chemical oxidation and dissolution of the substrate surface, *without* the additional or concurrent step of mechanical polishing or planarization using an abrasive slurry and polishing pad.

In view of the new amendments to claims 8 and 14 that recite chemically etching, Applicants respectfully submit that amended claims 8 and 14 are now distinguishable from CMP process. In other words, claims 8 and 14 do not recite the use of abrasive particles, chelating agents, surfactants and importantly a polishing step (mechanical aspect in planarization) that are characteristic of CMP process. Instead, claims 8 and 14 are directed to a method of chemically etching, *i.e.*, removing, cleaning and rinsing the chemically etched residue by using an oxidant such as periodic acid or hydrogen peroxide. Unlike Scherber and Wang, the claimed invention does not include a mechanical aspect. There is no teaching in Scherber or Wang that suggests in any way that their teaching could be practiced *without* a mechanical aspect. Thus, amended claims 8 and 14 are unobvious over Scherber and Wang.

## **2. No Motivation or Suggestion to Combine Scherber and Wang**

Applicants respectfully submit that there is no suggestion in either Scherber or Wang to modify the references or to combine their teachings to arrive at the invention of amended claims 8 and 14. As discussed above both Scherber and Wang are directed to a polishing slurry composition and method for CMP (chemical mechanical planarization) of substrates. However, both Scherber and Wang fail to teach or suggest a method of chemically etching TiW and cleaning the TiW residue layer as defined in independent claims 8 and 14.

Contrary to the assertion in the Office Action that Scherber suggests polishing step in combination with etching to form residue and cleaning afterwards, Applicants respectfully submit that claims 8 and 14 do not define a polishing step, which is a necessary step of CMP method. Further, regarding the assertion that it would have been obvious to provide a substrate comprising an exposed TiW alloy layer and etching the TiW alloy by a method which results in formation of etching residue in the method of Scherber because Wang teaches that this is a useful technique for planarization substrates to enable USLI, Applicants respectfully point out that there is no motivation in Wang to provide a method of chemically etching the TiW alloy as defined in claims 8 and 14 because Wang is not directed to etching but to CMP, *i.e.*, mechanical

planarization. Chemically etching does not constitute polishing or planarization of the exposed TiW substrate, and therefore, there is no motivation to planarize the TiW substrate by etching. Rather, claims 8 and 14 define chemically etching or chemical dissolution of the TiW alloy layer and cleaning of the dissolved residue using an oxidant without the mechanical planarization process.

As discussed before in our previous response, chemical etching involves removing the metal substrate and forming grooves in the substrate. Such grooves in the substrate are cleaned by, for example, a method as defined in claim 8, and a barrier layer may be deposited and the grooves subsequently filled up by adding excess conductive material (first layer). The CMP process typically as disclosed in Scherber and Wang removes the excess of overlying first layer, exposing the material disposed on the grooves or even removing the second barrier layer as in the case of Wang. Thus, chemically etching and cleaning are conducted before the first layer is added to the substrate and does not involve mechanical planarization of the substrate.

Accordingly, one skilled in the art of CMP of semiconductor surfaces, who is familiar with Scherber, would not look to Wang to solve problems relating to method of chemically etching, in part because neither Wang nor Scherber teach or suggest wet chemically etching of the TiW substrate and cleaning of the residue. Thus, for at least this reason, the combination of Scherber and Wang does not render obvious independent method claims 8 and 14.

### **3. Combination of Scherber and Wang Fails to Teach All Elements of Claims 8 and 14**

Applicant submits that even if there was suggestion or motivation to combine Scherber and Wang — which as discussed there is not — the combination does not teach all the limitations of the invention of amended claims 8 and 14. Scherber does not teach or suggest the limitations of chemically etching the exposed TiW alloy and removing the TiW etch residue using periodic acid or hydrogen peroxide. As discussed above, Scherber discloses a CMP process and does not solve the problem of etching of exposed TiW alloy. Similarly, Wang teaches a two-step CMP process involving exposing the substrate in the first step by polishing method and removing the exposed substrate in the second step also by polishing method. Clearly, the combination of Scherber and Wang fail to teach the steps of chemically etching of exposed TiW alloy using an

oxidant such as periodic acid and cleaning the dissolved etched substrate residue. Thus, there is no valid basis to combine these references but, even if the references are combined, the Applicants' invention does not result. For this additional reason, the combination of Scherber and Wang fails to render obvious the subject matter of claims 8 and 14.

#### **4. Conclusion**

Since amended independent claims 8 and 14 define subject matter that are non-obvious over Scherber alone or in combination with Wang and that there is no motivation or suggestion to combine Scherber with Wang in either of the references, the obviousness rejections are overcome. Accordingly, Applicants request reconsideration of the claims and allowance of claims 8 and 14. Additionally, Applicants submit that because independent amended claims 8 and 14 are allowable over Scherber and Wang, dependent claims 9-13 and 15-18 that depend from claims 8 and 14 respectively are also allowable.

### III. Request for Allowance

In view of the amendments and arguments presented above, all claims are now thought to be in condition for allowance, an indication of which is solicited. In the event that any issues remain outstanding, Applicants would appreciate the courtesy of a telephone call to the undersigned counsel to resolve such issues in an expeditious manner so as to place this application in condition for allowance.

No fees are believed to be due. However, if any additional fees are determined to be due, the Commissioner is hereby authorized to charge these fees to the Morgan, Lewis & Bockius Deposit Account no. 50-0310.

Respectfully submitted,

**MORGAN LEWIS & BOCKIUS LLP**



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